

Graphic Cigarette Warning Labels: The Effect of Arousal on Long Term Memory

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Abstract

The Family Smoking Prevention and Tobacco Control Act of 2009 (called the Tobacco Act or the Act from hereon) mandated that the U.S. adopt graphic cigarette warning labels similar to those used by European and Latin American countries to control the prevalence of smoking. Tobacco companies successfully litigated FDA's selection of graphic warning labels based on this section of the Act on the grounds that the labels were picked based solely on emotionality and, thus, were unconstitutional. Prior research has shown that emotionally charged warnings may help to reduce smoking's prevalence by improving a smoker's memory for the long term health effects of smoking and causing smokers to perceive smoking as a high risk, low reward activity. We conducted a between subjects design in order to test whether the level of graphicness used in a warning label influenced either warning credibility or long term memory. We found that highly graphic images do not significantly improve long term recognition memory compared to text-only warning or less graphic images. However, graphic images did improve credibility of the warnings relative to a text-only condition. This could indicate that highly graphic warning labels are no more effective than low graphic warning labels at conveying the dangers of smoking, but that they make the warning more credible.

Introduction

On January 14, 2014 Surgeon General Boris Lushniak released *The Health Consequences of Smoking —50 Years of Progress* which analyzes the last 50 years of research on tobacco. Some of the report's findings were that each year the negative health effects of tobacco cost the United States \$130 billion in direct medical costs, \$150 billion in lost productivity due to premature death in smokers, and \$5.6 billion due to premature death in nonsmokers.¹ In terms of mortality, smoking has killed 20,830,000 Americans since 1965, including 2,457,000 from exposure to second hand smoke, and 86,000 from residential fires related to smoking. In addition, if trends continue to hold, 5.8 million children currently younger than 18 will die prematurely from smoking-related health complications during adulthood. These mortalities are so high because smoking has been tied to diseases of almost every major organ in the body including lung, liver and colorectal cancers, diabetes, rheumatoid arthritis, and cardiovascular disease (U.S. DHHS, 2014).

One method used by some countries in attempts to reduce the prevalence of smoking is the implementation of graphic warning labels on cigarette packages. Research has shown that knowledge of the health effects of cigarettes is generally low among smokers (Hammond et al., 2006). In the U.S., more than one quarter of smokers do not believe that smoking causes strokes in smokers or lung cancer in non-smokers. Furthermore, only 34% believe that smoking causes impotence (Hammond et al, 2006). In reality, almost 40,000 adult nonsmokers die every year in the U.S. due to second hand smoke, smokers are 2 to 4 times more likely to have a stroke compared to nonsmokers, and they are at a 24% to 39% greater risk of erectile dysfunction compared to nonsmokers (US DHHS, 2014; Shah & Cole, 2010; Millet et al., 2006).

¹ In comparison, the projected budget of NASA from 2012-2017 is only \$106.3 billion (NASA, 2012).

Life expectancy in smokers is shortened by ten years on average, but smoking cessation has a significant impact on this figure regardless of the age at which it occurs (Jha et al., 2013). Quitting smoking between the ages of 25 to 34, 35 to 44 and 45 to 54 has been shown to increase life expectancy by an average of 10, 9 and 6 years, respectively (Jha et al., 2013).

Graphic warning labels on packages take advantage of the fact that one of the most accessible sources of information for smokers is the cigarette pack itself. Hammond and colleagues (2006) found a significant relationship between strength of package warnings (e.g., whether the package displays a text-only warning, or a warning plus a relevant, graphic picture) and the likelihood of reporting a cigarette package as a source of information. In Canada, the first country to use these strong graphic warnings, 84% of smokers cite the cigarette package as a source of information compared to only 47% of U.S. smokers. Hammond and colleagues (2006) also showed that smokers who notice warnings are 1.5 to 3.0 times more likely to endorse the negative health effects of smoking, and that smokers who read, think about, and discuss health warnings are more likely to express intentions to quit in the next six months. Kees and colleagues (2010) further showed that the level of graphicness is positively associated with intentions to quit such that more graphic labels (such as those that display pictures of mouth cancer) produced greater quit intentions compared to less graphic labels and text-only warnings.

Despite the large amount of evidence supporting the efficacy of graphic cigarette warning labels and detailing the damage caused by smoking and other tobacco products, the US government has not yet implemented a system of graphic warnings. The Family Smoking Prevention and Tobacco Control Act, signed into law on June 22, 2009, was meant to rectify this situation (FSPTCA, 2009). Sections 201 and 204 of this act mandated that the top 50% of both the front and back of cigarette packages be covered by a graphic warning label to be determined

and then put into effect by FDA by September 2012 (FSPTCA, 2009). However, several tobacco companies including Lorillard Inc. and R.J. Reynolds Tobacco Co. litigated these provisions in court (RJ Reynolds v FDA, 2012). The tobacco companies claim that the graphic labels selected by the FDA infringe on their first amendment rights by going beyond being informational and forcing the cigarette companies to engage in “anti-smoking advocacy” on the government’s behalf.

US District Court Judge Richard Leon granted a temporary injunction, pending a decision by the circuit court, to the tobacco companies stating that it was “abundantly clear from viewing these images that the emotional response they were crafted to induce is calculated to provoke the viewer to quit, or never to start smoking - an objective wholly apart from disseminating purely factual and uncontroversial information” (RJ Reynolds v FDA, 2012). This ruling was upheld in a majority ruling by the DC circuit court which expressed concern that the graphic warning label regulation would “force the manufacturer of a product to go beyond making purely factual and accurate commercial disclosures and undermine its own economic interest.” In addition, the majority also ruled that the FDA failed to prove that the graphic warning labels would “directly” cause a decrease in the smoking rates in the U.S. (RJ Reynolds v FDA).

Why might graphic warning labels be effective? Although in the real world, risk and reward are usually positively correlated (i.e., stocks are riskier than bonds but have traditionally offered higher returns), human beings tend to perceive risk and reward as being negatively correlated (Finucane, Alhakami, Slovic, & Johnson, 2000). This leads individuals to believe that objects that are high in benefit tend to be low in risk whereas those that are high in risk tend to be low in benefit. Through a process known as the affect heuristic, humans tend to judge the risk of an object through their feelings; rather than using deliberate thinking and objective knowledge,

they use their feelings or emotional state to guide their perceptions of risk and benefit (Slovic, Finucane, Peters & MacGregor, 2004). Therefore, positive and negative qualities are not always ascribed to objects via cognition. Instead, judgments of risk are often the result of the affective quality of the object (Klauer & Stern, 1992).

In similar fashion, cigarette advertisements that emphasize the positive aspects of smoking may engender a skewed perception of smoking as a low risk/high reward activity. Conversely, negative affect laden graphic warning labels may cause a perception of risk more in line with it being high in risk and low in reward (Kees et al., 2010). One important factor that influences judgments of risk via the affect heuristic is how vividly the outcomes can be imagined (Loewenstein, Weber, Hsee, & Welch, 2001). For instance, Browne and Hoyt (2000) showed that purchases of flood insurance in one year are positively correlated with flood losses during the prior year. This could mean that individuals were more likely to purchase insurance after suffering a loss because the vivid memories of the damage caused them to judge the risk as more severe. For graphic warning labels, this may mean that a highly vivid image, such as of a diseased lung, may cause the risk of smoking to be judged as more severe relative to a less vivid image, such as of a man coughing with an oxygen mask. See figure 1 below for examples of stimuli used in our experiment.

Concentrate carefully on the text and image



Concentrate carefully on the text and image



Figure 1: Two warnings about fatal lung diseases used in the experiment. The low graphic warning is on the left and high graphic is on the right.

Some evidence exists, however, that highly graphic warning labels (such as those that display pictures of mouth cancer) may reduce recall of the associated health warning compared to less graphic labels (Kees et al., 2010). In particular, Kees et al. found that only 60% of participants recalled the health warning when it was associated with a highly graphic warning compared to 78% who recalled it when it was associated with a low graphic warning, and 70% who recalled in the text-only condition. A potential reason for Kees and colleague's (2010) results is the heightened arousal caused by the emotionally intense graphic warning labels and its negative effects on short-term memory (Cuthbert, Schupp, Birbaumer & Lang, 2000). Arousal, however, appears to have opposite effects on long-term memory, but this long-term memory was not studied by Kees et al.

In particular, Kleinsmith and Kaplan (1963) exposed participants to a number paired with a word, while measuring their reaction using skin conductance response. They found that, when tested soon after exposure (after two minutes), participants' memories were poorest for numbers paired with words that caused high arousal (e.g., vomit) than those that caused low arousal (e.g., swim). However, memory for the number paired with the low arousal word declined rapidly over

time, and recall was reduced by approximately 75 percent one day after exposure. Conversely, recall for the number paired with the high arousal word increased over that same time period by approximately four times, such that, over time, learning was significantly greater for the high arousal word/number pairs than for the low arousal pairs. Kees and colleagues' (2010) previous research testing for the recall of tobacco warnings paired with highly graphic pictures tested participants only immediately after exposure. Their finding that highly graphic (arousing) pictures impeded memory, at least in the short term, is consistent with Kleinsmith and Kaplan's (1963) findings. Based on these 1963 findings, however, it is plausible that more graphic warning labels will significantly increase memory after a longer delay relative to less graphic warnings.

More recently, Mather and Sutherland (2011) have proposed a theoretical framework that describes the effect of arousal on memory dubbed Arousal-Biased Competition (ABC). Mather and Sutherland's (2011) main argument is that arousal modulates the strength of competing mental representations which can, in turn, enhance the perception of and subsequent long term memory for different stimuli. In ABC, an item's priority (which determines how quickly and precisely the item is perceived) decides whether arousal will impair or enhance memory for that object. In other words, memories for high priority items are enhanced, relative to low priority items, whereas memories for low priority items are impaired, relative to high priority items. The process by which an item's priority is determined involves aspects of both top-down and bottom-up cognitive processing.

One determinant of priority is the contrast of an image compared to the background, with images of higher contrast being the highest priority (Itti, Kock & Neibur, 1998; Treue, 2003). Since graphic labels sharply contrast with the cigarette package to which they are added, then we

should expect that contrast to increase their priority. A second important determinant of priority that involves both bottom-up and top-down cognitive processing is emotion. Emotional stimuli induce specific behavioral reactions, such as the tendency to visually fixate first on an emotional image rather than a non-emotional image, and neural reactions, such as increased processing in the inferotemporal cortex, which is vital for object recognition and faster initial response in the occipital lobe (Knight et al., 2007; Sabatinelli et al., 2007; Miller et al., 1991; Schupp et al., 2007). Thus, even when participants are not aroused, emotional stimuli should tend to be high priority. In addition, arousal, caused by either the emotional stimuli or another source, should serve to further increase the priority of emotional stimuli (Mather & Sutherland, 2011). This means that the highly graphic images should have a two-fold advantage over the less graphic images in terms of priority in perception. The increased emotionality of the highly graphic images should increase their baseline priority, while the increased arousal induced by the highly graphic images relative to the less graphic images should further increase the priority of the highly graphic images. Compared to text-only warnings, graphic images are more emotional and arousing and they may also contrast more with the cigarette package, suggesting an even greater difference in priority (perception) for graphic images versus text-only warnings.

Following its effect on perception, arousal proceeds to affect memory for both the central and peripheral visual details of a scene in two stages according to the ABC model: Arousal acts first during the encoding period for new memories, and then it acts during the memory consolidation stage. Arousal's main effect on memory encoding is to focus attention and memory on the central aspects of a scene (Levine & Edelstein 2009). For example, the most recognized example is the "weapon focus effect" in which the presence of a weapon reduces the ability of eye witnesses to recall the peripheral details of a scene, such as the clothes or face of the

individual holding the gun (Loftus, Loftus, & Messo, 1987). In a separate experiment conducted by Guillet & Arndt (2009), participants were instructed to carefully read sentences containing either neutral or taboo (arousing) words, but were not told there would be a memory test after. Following their reading, participants who read sentences with taboo words had better memory for central details (the taboo word itself) as well as peripheral details (the other words around the taboo word). In order to reconcile these two findings, ABC posits that arousal enhances encoding of the highest priority item (Mather & Sutherland, 2011). In Guillet and Arndt's (2009) experiment, the peripheral words have increased priority because the instructions led participants to pay more attention to the sentences (Mather & Sutherland, 2011). That is, because participants were told to carefully read the sentences, more attention was paid to the central and peripheral details. Our experiment uses instructions similar to those used by Guillet and Arndt (2009). In other words, participants in our experiment were told to study the images and text carefully, but they were not told there would be a memory test after. Therefore, we should expect the highly graphic images (central detail) to be encoded better than the less graphic images due to their increased emotionality. Furthermore, we should expect improved recall for the textual warnings (peripheral detail) in the highly graphic condition due to the arousal amplifying the effects of the instructions on attention relative to the less graphic condition (Mather & Sutherland, 2009). Arousal appears to cause these effects by activating the amygdala, resulting in increased activation of the fusiform and primary visual cortex, which play a large role in object recognition (Vuilleumier, 2005). This is corroborated by studies that have demonstrated that amygdala lesions can abolish this enhanced visual processing (Vuilleumier et al., 2004).

Finally, arousal acts during the consolidation of memories in order to improve memory for high priority items. Sharot and Phelps (2004) replicated and expanded on Kleinsmith and

Kaplan's (1963) original findings. Sharot and Phelps (2004) found that the arousing word could be flashed in the periphery while participants' attention was focused on a central word and still produce a reliable increase in long term memory. While memory for items paired with arousing stimuli is often improved, arousal also increases memory for the arousing stimulus itself (Bradley et al., 1992). This means that arousal could improve memory for not only the graphic image (central detail) in the warning label, but also the textual message (peripheral detail). Arousal produces these effects by signaling the adrenal glands to release stress hormones, which, in turn, causes the amygdala to release norepinephrine. The norepinephrine released by the amygdala has been shown to increase plasticity in hippocampal synapses associated with memory (McIntyre et al., 2012).

However, recent research suggests that the valence of the arousing stimulus may modulate the effect of arousal on consolidation (Kensinger, 2009). Indeed, neural imaging studies show that negatively valenced objects activate the right fusiform area, an area involved in advanced perceptual processing, more than positively valenced objects do (Kensinger & Schacter, 2008). Although positive valence objects increase left prefrontal and temporal activity (areas involved in the semantic encoding of an object), negatively valenced objects increase right fusiform activation, an area involved in object recognition (Kensinger & Shacter, 2008). This is consistent with previous research that has demonstrated that negatively valenced arousing images improve memory for the perceptual details of an object such as details located peripheral to the arousing stimulus, whereas positively valenced objects improve memory for the gist of an object's meaning (Kensinger, 2007; Levine & Bluck, 2004). In sum, the ABC framework is consistent with an expectation that memory for the adverse health effects of smoking should be improved when presented with highly graphic stimuli, due to the arousing nature of the image,

which draws attention to the label, and due to the negative valence of the image, which improves memory for the health warning located in the periphery.

Therefore and consistent with the findings of Kees and colleagues (2010), we hypothesized that those participants exposed to highly graphic warning labels will have worse immediate recall of the associated text warnings compared to those exposed to less graphic warning labels or a control (no graphic) text-only condition. In addition, based on the findings of Kleinsmith and Kaplan (1963), we hypothesized that participants in the highly graphic condition will have better recall of the associated text warnings at the one week follow-up than those in the less graphic and text-only conditions.

If our hypotheses are supported, there would be two major implications for the future of graphic warning labels in America. First, it would show that graphic warning labels support the FDA's primary goal, which is to "effectively convey the negative health consequences of smoking on cigarette packages and in advertisements" (RJ Reynolds v FDA, 2012). That is, more graphic labels help convey factual information more effectively by increasing long term retention of the paired textual warnings. In addition, this research might be able to be used later on to demonstrate that graphic warning labels can be directly linked to a decrease in rates of smoking in the U.S.

Method

The goal of the experiment was to measure the effect of varying levels of arousal on participants' long term memory. Participants were exposed to a set of eight images of varying graphicness, paired with a complementary textual warning. The level of graphicness ranged from text-only (a no-graphic control condition) to low, high and mixed graphicness. The mixed condition was made up of four low and four high graphic images, counter balanced such that half

the participants saw the one set of four low and four high graphic images whereas the other half saw the other set of four high and four low graphic images (please refer to Appendix A to see the specific images used in each condition). Recall was tested at two different times; either immediately following exposure or one week after exposure. Thus, we had a 4 (Level of graphicness: Text-only, low, mixed, high) x 2 (Time delay: Immediate, one week) design. A six week delay condition is also being collected, but is not a part of the analyses presented in this thesis.

Pilot Study

In a pilot study prior to this experiment, graphic images proposed by the FDA in response to the Family Smoking Prevention and Tobacco Control Act as well as other labels used internationally were pretested for graphicness (Meilleur & Peters, 2011). Specifically, college-student participants were asked “How graphic is this picture?” on a 7-point scale ranging from 0=“Not at all” and 6=“Very graphic”. Mean graphicness for all pictures was 2.92 with a standard deviation of 1.41. Cutoffs for high and low graphicness were determined by taking the mean plus or minus .75 standard deviations, yielding an upper cutoff of 1.86 for low graphic and a bottom cutoff of 3.99 for high graphic. Average graphicness was $M=4.84$ for selected high graphic labels, $M=1.35$ for low graphic and $M=3.2$ and $M=2.95$ for each of the mixed graphic conditions, respectively. Although Congress mandated nine text warnings, no adequately graphic (arousing) images were available for warning number 5 (Smoking during pregnancy...). As a result, this warning was excluded and eight text warnings were tested across our conditions.

Participants

For the study, $N=363$ participants were recruited from Amazon.com’s Mechanical Turk online subject pool by first posting a prescreen survey to the site. The prescreen took less than

five minutes for participants to finish and allowed us to identify smokers, our demographic of interest, for the study. Participants were incentivized \$0.25 to complete the prescreen survey. During the prescreen, participants were asked “What is your age?”, “Have you smoked more than 100 cigarettes in your life?” and “How often do you smoke cigarettes?”. The final question was asked on a 6 point response scale made up of: “Every day”, “Some days”, “Occasionally”, “Rarely”, and “Not at all”. Participants who smoked “Every day” or “Some days”, reported smoking at least 100 cigarettes during their life, and were eighteen or older were presented with a screen telling them “Thank you for completing the qualifications of our study. You are eligible to participate and can do so by clicking on the link below. The survey will take approximately 30 minutes to complete. If you complete the survey below, we will add a \$4.00 bonus to your account. You may also be randomly selected for a follow up survey in the coming weeks for an addition \$2.00 bonus” with the link to the follow up survey located below this text.

Procedure

At the beginning of the experiment, participants completed a series of individual difference measures including a section of the Test of Functional Health Literacy in Adults (Baker et al., 1999), questions about exposure to industry advertising and promotions, media use, tobacco use, the acceptability of smokeless tobacco use, demographics, the participant’s own tobacco use in the previous week, and how often they have thought about smoking health risks in the previous week. Please refer to Appendix B for a complete ordered list of individual difference measures used. Individual difference measures were not the focus of the present thesis and will not be discussed further.

Following these measures, participants were randomly assigned to the low graphic, high graphic, mixed graphic and text-only conditions as well as to the immediate recall or delayed

recall conditions. All participants saw the same eight text messages that were mandated in the Tobacco Act. Participants in the low, high, and mixed condition were then exposed to a set of eight text and picture (graphic) warning labels with their associated text warnings, while participants in the text-only condition were exposed to the text warnings only. Participants in the low, high and mixed conditions were told “In the following section, you will be presented with a series of cigarette warning labels that have either been proposed for use or are currently in use around the world. Concentrate carefully on both the text and the image on each screen”.

Participants in the text-only condition were told “In the following section, you will be presented with a series of cigarette warning labels that have either been proposed for use or are currently in use around the world. Concentrate carefully on the text on each screen.” Participants in the low, high and mixed graphic conditions saw a message above each warning telling participants to “Concentrate carefully on the text and image”. Participants in the text-only condition were just told to “Concentrate carefully on the text”.

The text warnings were taken directly from the Family Smoking Prevention and Tobacco Control Act. The graphic warning images consisted of those proposed by the FDA in their Final Rule plus other graphic images used internationally. International sources were used because pretest results indicated that many of the FDA proposed images were rated as much less graphic compared to those in use internationally. Participants were able to view the warnings for as long as they liked (*ad libitum*) and had to manually click to move on to the next warning. All graphic warnings were standardized to 375 pixels 248 pixels and text warnings were standardized to 375 pixels x 120 pixels. To avoid rehearsal, participants were not informed that they would be tested for recall.

Following exposure but prior to recall, participants were asked questions concerning tobacco use risk perceptions, endorsement of smoking myths (Finney et al., 2008), quit intentions (Beiner & Abrams, 1991) and expected tobacco use for the following week (see Appendix B). Participants in the immediate recall condition were then tested for recall using three separate measures. First, participants saw a free recall measure where they were presented with eight boxes and asked to “Please think about the 8 cigarette warnings you saw at the beginning of the study. Try to recall what the warning information was and write in below as many of the 8 warnings as you can recall. Please write one warning in each of the 8 boxes.” Second, participants in the low, high and mixed graphic conditions saw a cued recall measure where they were instructed “In the next task, please try to remember the text warnings that were shown with the following images when you saw them before. Write what you remember about the text warning in the spaces provided. If you don’t remember, please write “don’t remember.”” Participants were then presented with each of the graphics (but not the associated text warning) they had previously seen one at a time and asked “What was the text warning shown with this image?” Finally, participants saw a recognition measure where they were presented with a list of six of the adverse health effects they had seen earlier, six new adverse health effects of smoking, such as infertility and liver disease, and six health effects that are not at all related to smoking, such as botulism and rabies. Participants were asked “Which of the following health effects were mentioned in the warnings we showed you?” and asked to decide between “Yes, I saw this health effect” or “No, I did not see this health effect”. Only the results of the recognition measure will be reported in this thesis.

Whereas participants in the immediate conditions completed the memory measures, participants in the delayed conditions were presented with a screen stating “Thank you for your

participation in our study. We would like to invite you to participate in a follow up study next week. The study will take approximately 20 minutes, and for your participation you will be awarded a bonus payment of \$2.00, once the follow up study is completed. If you decide to participate, we will send you a link to the study via Mechanical Turk's messaging system in one week. Would you like to participate in the followup study?" with a "Yes"/"No" response. The participants who opted into the follow up were contacted one week later and sent a follow up survey. Participants who did not complete the followup survey the day we sent it out, were contacted during each of the following two days with reminders to complete the followup. The follow up survey contained recall measures identical to those seen by the participants in the immediate condition.

Manipulation check and Warning credibility measures

Following the recall measures, participants in the immediate and delayed conditions were also asked:

- **Affect Manipulation Checks:** Participants in the low, high and mixed graphic conditions were asked to rate their emotional response to each image on three 6-point scales. The first scale asked participants to rate how anxious the images made them feel (1=Not at all anxious, 6=Very anxious), the second asked how nervous the images made them feel (1=Not at all nervous, 6=Very nervous) and the third asked participants how fearful the images made them feel (1=Not at all fearful, 6=Very fearful) (Kees et al., 2010). In addition to the scales, participants also rated each image using the Self-Assessment Manikin, a non-verbal pictorial technique that allowed the participants to rate the images on a 5 point pictorial scale of valence, ranging from "Negative" to "Positive" and arousal, ranging from "Calm" to "Excited" (Bradley & Lang, 1994). Since we were not capable of

measuring arousal physiologically, this measure will act as a self-report measure for arousal and allow us to assess whether the highly graphic images were perceived as more arousing than the less graphic images.

- **Warning Credibility:** Was assessed at the end of the study and with exposure or re-exposure to each warning image and text message. “How much do you believe the information in the warning labels was true or false?” on a 9-point scale ranging from -4 (completely false) to +4 (completely true) (Peters, Romer, Slovic, Jamieson, Wharfield, Mertz & Carpenter, 2007).

Participants in the delayed condition were asked the same questions in the same order as those in the immediate condition to assess recall. In addition, participants in the delayed condition were also asked the following questions at the end of their study that had not been asked of participants in the immediate condition:

- **Information rehearsal and Depth of Processing:** Because arousing images were expected to increase information rehearsal over time, participants in the delayed condition were asked “How often have you thought about the health warnings you read last week?” on a 5-point Likert scale ranging from 1 = not at all to 5 = extremely often (Hammond, Fong, McDonald, Brown & Cameron, 2004). Additionally, participants were asked “In the past week, how often have you noticed the warning labels on cigarette packages?” on an identical 5-point Likert scale.
- **Exposure and Response to Warnings:** In order to assess what effect viewing the warning labels had on participants we asked them to respond to four questions on a 5 point scale where 1=Not often and 5=Very often (Hammond, Fong, Borland, Cummings, McNeill & Driezen, 2007). The questions were: “In the past week, have you noticed advertising or

information about the dangers of smoking or encouragements to quit?”, “In the past week, have health warning labels stopped you from having a cigarette when they were about to smoke one?”, “In the past week, have health warning labels made you think about smoking’s health risks?”, “In the past week, have health warning labels led you to think about quitting?”

For purposes of the present thesis, we will focus on the affect manipulation checks, recognition memory, and warning credibility.

Results

Participant Statistics

In total, 323 smokers (42.4% female; mean age=31.7) were recruited for the experiment. Of those, 162 were in the immediate condition, and 161 were in the delayed condition. Of the 162 participants recruited into the immediate condition, 161 completed the initial survey (99.38% completion), and of the participants recruited into the delayed condition, 126 completed the followup survey (78.26% retention). Across the eight conditions (Immediate: text-only, low, mixed, and high graphic and Delayed: text-only, low, mixed, and high graphic), sample sizes were 45, 39, 42, 36, 30, 42, 41, 48, respectively.

Looking time at warning labels

Condition	Mean Stimulus Exposure Time in seconds (s)
High	5.56 (0.57)
Mixed	4.79 (0.52)
Low	5.73 (0.56)
Text-only	4.23 (0.72)

Table 1. Average looking time by graphic condition

Average looking time at the labels ranged from 4.23s in the text-only condition to 5.73s in the low graphic condition; however, these differences did not approach significance ($F(1,322)=1.36$, $p=.25$). See Table 1.

Arousal Manipulation check.

We first compared levels of graphicness between the low, mixed, and high graphic conditions using analyses of variance. There were significant differences between groups on both SAM measures, ($F(2, 1754)=6.22$, $p<0.0024$ for arousal and $F(2,1754)=7.50$, $p=0.0007$ for valence). Further paired sample t test showed that the highly graphic condition was significantly more arousing and negative in valence than the mixed ($t(1177)=16.66$, $p<0.0001$; $t(1177)=32.21$, $p<0.0001$ for arousal and valence respectively) and low ($t(1170)=74.00$, $p<0.0001$; $t(1170)=81.07$, $p<0.0001$ for arousal and valence respectively) graphic condition, and that the mixed condition was significantly more arousing and negative than the low graphic condition ($t(1154)=18.29$, $p<0.0001$; $t(1154)=9.60$, $p=0.002$ for arousal and valence respectively). Similar analyses did not reveal significant differences between groups in regards to feelings of anxiety/nervousness/fearfulness ($t(1754)=1.70$, $p=.18$; $F(2,1754)=1.72$, $p=.18$; $F(2,1754)$, $p=.12$, respectively) See Table 2 for means and standard errors calculated across all graphic images in each condition.

	Arousal	Valence	Negative Emotion		
Condition	SAM Arousal Measure (1=Calm 5=Exciting)	Sam Valence Measure (1=Negative to 5=Positive)	Feelings of Anxiety (1=Not at all to 6=Very)	Feelings of Nervousness (1=Not at all to 6=Very)	Feelings of Fearfulness (1=Not at all to 6=Very)
High	3.36 (0.05)	1.62 (0.03)	4.65 (0.04)	4.68 (0.04)	4.84 (0.04)
Mixed	3.08 (0.05)	1.92 (0.04)	4.65 (0.04)	4.60 (0.04)	4.65 (0.04)
Low	2.77 (0.05)	2.11 (0.05)	4.54 (0.04)	4.60 (0.04)	4.65 (0.04)

Table 2: Results for self report arousal, valence, and emotion measures. Averages (standard errors) for each of the five self report measures across every graphic image are reported in each condition with standard errors in parentheses. NOTE: The control is absent since no graphic images were presented in the control condition; only textual warnings were presented.

Recognition Check

The main dependent variable for the purposes of this thesis was the number correct on the recognition memory test. For this measure, participants had to decide whether they had been previously warned about a series of health risks. Three types of health effects were used: Health risks of smoking that had been previously seen, health risks of smoking that had not been previously seen, and health effects that are unrelated to smoking. We compared the average proportion of correct responses for each of the three types of health effects across participants. The average proportions correct (SEs) were 88.8% (0.75), 75.5% (1.04), and 96.9% (0.42), respectively, for the seen health risks of smoking, unseen health risks of smoking, and health effects unrelated to smoking.

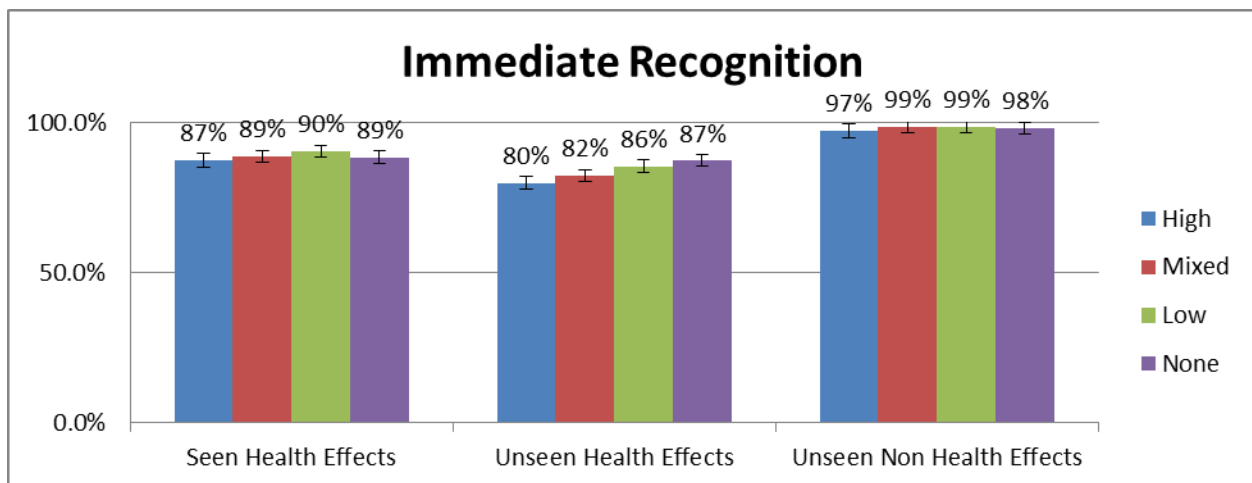
To test our hypotheses, we compared participants in the immediate versus delayed conditions on the seen health risks of smoking. Based on previous work (Kleinsmith & Kaplan, 1963; Sharot & Phelps, 2004), we predicted a significant interaction between graphicness (from most graphic to least graphic; we assumed that the text-only condition was the least graphic) and

delay condition (immediate vs. 1 week delay). Participants in the high graphic condition were expected to have fewer correct responses in the immediate condition compared to participants in the less graphic conditions. Conversely, in the delayed recall condition, participants in the highly graphic condition were expected to answer correctly more often in the more versus less graphic conditions.

An ANOVA of the data revealed no significant interaction of graphicness and delay condition for correct identifications of seen health risks ($p=.85$; See Table 3 and Figure 1). No significant effects emerged for the Delay or Graphic condition variables either.

Variable	DF	Type III SS	Mean Square	F Value	P Value
Delay Condition	1	0.000	0.000	0.00	0.9871
Graphic Condition	3	0.017	0.006	0.30	0.8228
Delay*Graphic	3	0.015	0.005	0.27	0.8477

Table 3. ANOVA results for proportion of correct identifications of seen health risks



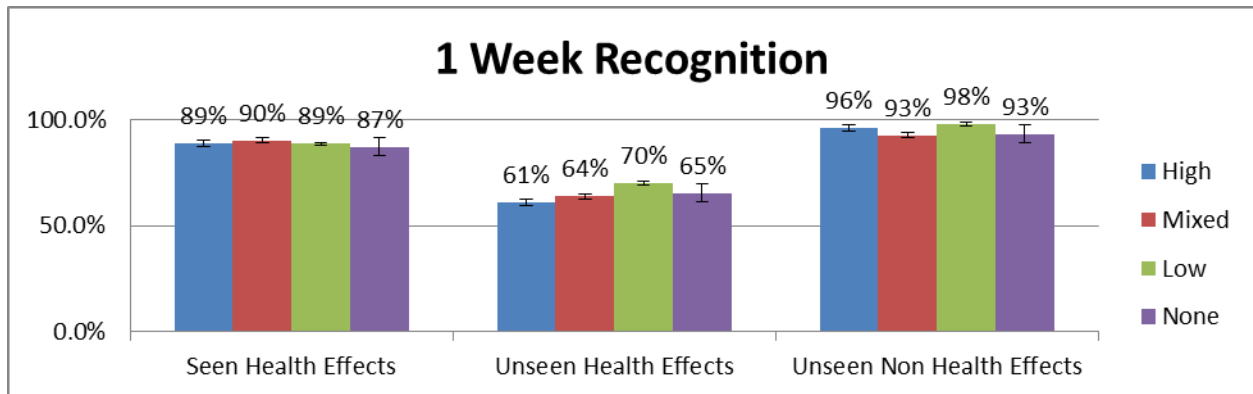


Figure 1: Results for recognition measure. Averages for the number of correct identifications/rejections across level of graphicness for the immediate and delayed conditions. NOTE: Analyses are in progress, error bars are SE.

For these analyses, taking into account both correct identifications and correct rejections is critically important. Having a large amount of correct identifications but a low amount of correct rejections is indicative of answering positively indiscriminately, whereas high numbers of correct identifications and rejections is indicative of a clear recollection of what was and was not presented. Examining the ANOVAs for the unseen health risks reveals a nonsignificant interaction of graphicness and delay condition ($p=.83$). Delay condition had a significant main effect on correct identifications for both types of unseen health risks such that participants remembered less after the delay than they did immediately. See Tables 4 and 5.

Variable	DF	Type III SS	Mean Square	F Value	P Value
Delay Condition	1	2.571	2.571	55.33	<0.0001
Graphic Condition	3	0.268	0.089	1.92	0.1263
Delay*Graphic	3	0.040	0.013	0.29	0.8333

Table 4. ANOVA results for proportion of correct identifications of unseen health risks of smoking.

Variable	DF	Type III SS	Mean Square	F Value	P Value
Delay	1	0.071	0.071	5.37	0.0212

Condition					
Graphic Condition	3	0.031	0.010	0.79	0.5025
Delay*Graphic	3	0.038	0.012	0.95	0.4162

Table 5. ANOVA results for proportion of correct identifications of unseen health risks unrelated to smoking.

Warning Credibility

Although long term recognition memory was not significantly improved by the use of highly graphic warning labels, repeated measure analyses of variance revealed that graphicness was significantly associated with the credibility of the health warnings ($F(3, 1754)=3.21$, $p=0.02$). Further analyses demonstrated that of the three graphic conditions, only the low graphic labels were rated as significantly more credible than the text-only labels ($F(1, 967)=5.38$, $p=0.021$ for the low graphic vs. text-only comparison and $F(1, 967)=1.95$, $p=0.16$ for the high graphic vs. text-only comparison).

Condition	Warning Credibility (ranged from -4="Completely False" - +4="Completely True")
High	3.26 (0.06)
Mixed	3.12 (0.06)
Low	3.31 (0.05)
Text-only	3.16 (0.05)

Table 6. Mean ratings of warning credibility across graphic conditions.

Variable	DF	Type III SS	Mean Square	F Value	P Value
Delay Condition	1	2.951	2.951	1.85	0.17
Graphic Condition	3	15.329	5.110	3.21	0.02
Label	7	344.368	49.195	30.91	<0.0001

Table 7. Repeated Measures ANOVA results for warning credibility. Note: Labels were coded 1-9. Label 5 was the pregnancy label that was not included, thus a total of 8 labels.

Discussion

Based on the results of the SAM manipulation check, it is clear that participants perceived the highly graphic cigarette labels as significantly more arousing and negative than the mixed or low graphic labels. Furthermore, the mixed graphic labels were perceived as significantly more arousing and negative than the low graphic labels. In addition, no significant differences existed in the amount of time participants spent looking at the stimuli across graphicness conditions, which is in contrast to what was found in Peters, Romer et al., (2007). In their paper, participants exposed to graphic images vs. text-only messages looked at the warnings for an average of 8.4 seconds and 4.5 seconds, respectively, whereas in the present study, participants looked at the warnings, on average, for about 5.07 seconds regardless of graphic condition. This difference might be caused by either the demand effects induced by bringing

participants into a lab versus allowing them to complete the study at home. Alternatively, the difference could be because the textual warnings used by Peters, Romer and colleagues, were the same textual warnings that had been in use for decades in the U.S. In the present study, new textual warnings were used that have been mandated by Congress, but are not yet in use in the US. Such text warnings may attract more interest.

The results of the recognition memory test did not support our hypotheses. There was no significant interaction of graphicness and delay for any of the three types of recognition questions. However, performance on the unseen health effects of smoking, and unseen non health effects of smoking was significantly influenced by delay condition, such that participants were less accurate on these measures after the 1 week delay. Due to the nonsignificant influence of graphicness on performance on these measures, we cannot attribute the drop in performance to the graphicness of the labels, however. Rather, it is more likely that the drop in performance is due to forgetting during the delay.

One possible explanation for these unpredicted findings might be due to the ordering of the memory measures. Prior to beginning the recognition check, participants in the low, mixed and high graphic conditions completed a cued recall measure, during which participants were re-exposed to the original graphic warnings, without the additional textual warnings. A second explanation could be that the items we selected for the recognition measure are simply well known health effects of smoking. The six previously seen health risks chosen for the recognition check were heart disease, death, stroke, addiction, cancer and lung disease. Future studies may want to focus on lesser known health effects of smoking, such as infertility (as per Hammond et al., 2006).

Despite the fact that the recognition check did not confirm our hypothesis that highly graphic warning labels improve long term memory, we did find that graphic warning labels improved the credibility of warning labels. Interestingly, it was the low graphic condition that was rated as significantly more credible than the text-only condition. Although the high graphic condition was rated as only slightly less credible than the low graphic condition, there was not a significant credibility difference between the high graphic condition and the text-only condition. This could imply that perhaps it does not necessarily matter if the graphic labels used are highly graphic or low graphic. It does, however, appear to matter that the graphic warnings are not a mixture of high and low graphicness as credibility of the mixed condition was quite similar to that of the control condition.

One possible explanation for this difference could be that participants in the mixed graphic condition are able to compare the two types of warnings against one another. Participants in the high graphic and low graphic condition rated the warning labels as roughly equally credible, despite the differences in graphicness between the two conditions. Participants in the mixed condition on the other hand, are able to compare the high graphic and low graphic labels against one another. This could be leading them to rate the low graphic labels as less credible than the high graphic labels, leading to a lower mean warning credibility.

Although the wording of each warning was the same across conditions, the images used were different across conditions, and it was not clear whether participants responded to the credibility of just the text information or the combination of text plus image when images were present. Thus, any differences in credibility may be due to the presence of graphicness, the level of graphicness, or the particular images used. It may be, however, that simply having a

consistent pictorial representation (either all low graphic or all high graphic images) of the consequences of smoking will make text warnings seem more credible.

The credibility findings may have two major implications for health communication. First, the DC Circuit Court's decision to uphold the district court's injunction on the FDA's graphic warning labels rests on the lower court's decision to apply a particularly severe level of scrutiny to the labels. In *RJ Reynolds Tobacco Co. v FDA*, the FDA argued for the application of a lenient level of scrutiny from the *Zauderer v Office of Disciplinary Counsel*, Supreme Court of Ohio. In essence, the *Zauderer* standard refers to instances in which disclosure requirements are "reasonably related to the State's interest in preventing deception of consumers." In 2005, the U.S. District court of the District of Columbia ruled in the case *U.S. v Philip Morris Tobacco Co.* ruled that "substantial evidence establishes that Defendants have engaged in and executed – and continue to engage in and execute – a massive 50-year scheme to defraud the public, including consumers of cigarettes." These deceptive acts including marketing cigarettes brands as "light" or "low tar" despite the fact that these cigarettes were at least as hazardous as full flavored cigarettes.

Graphic warning labels are "reasonably related to the State's interest" in several ways so that application of a more lenient standard may result in FDA being able to mandate them. First, based on our results, graphic images help participants to perceive warnings as more credible. Since participants who think about and discuss warnings are more likely to express increased intentions to quit in the following 6 months, our result may indicate that graphic images could help to increase the motivation of smokers across the country to quit smoking. Because of the enormous costs, both financial and in terms of human lives, the FDA may have grounds to argue for a substantial interest in preventing the deception of consumers by the tobacco companies.

The use of graphic warnings to improve the credibility of textual warnings can also be used in fields other than smoking. For instance, an anti-vaccination movement has recently begun to flourish in some parts of the U.S. Requiring parents to sign a consent form that shows text warnings combined with graphic images prior to being allowed to opt out of having their child vaccinated may cause some parents to believe the warnings more about not having children vaccinated. This could, in turn, motivate some parents, who otherwise would not vaccinate, to vaccinate their children.

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Appendix 1: Graphic Labels by Condition

High Graphic Condition > 3.99, M=4.84




Image			
FDA Warning	Warning: Cigarettes cause cancer	Warning: Smoking can kill you	Warning: Cigarettes cause strokes and heart disease
Graphicness	5.6	4.6	4.8
Name	High Graphic 1	High Graphic 2	High Graphic 3






Image		None	
FDA Warning	Warning: smoking causes fatal lung disease	Warning: Smoking during pregnancy can harm your baby	Warning: Tobacco smoke can harm your children
Graphicness	5.2	Note: Max graphicness 3.0	5.1
Name	High Graphic 4	NA	High Graphic 6

Image			
FDA Warning	Warning: Cigarettes are addictive	Warning: quitting smoking now greatly reduces serious risks to your health	Warning: Smoking causes fatal lung disease in nonsmokers
Graphicness	4.7	4.7	4.0
Name	High Graphic 7	High Graphic 8	High Graphic 9

Low Graphic Condition < 1.86, M=1.35



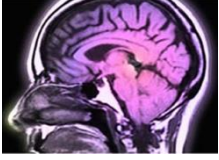
Image			
FDA Warning	Warning: Cigarettes cause cancer	Warning: Smoking can kill you NOTE: writing in graphic edited out	Warning: Cigarettes cause strokes and heart disease
Graphicness	1.4	1.8	1.4
Name	Low Graphic 1	Low Graphic 2	Low Graphic 3




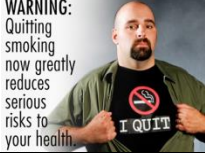

Image		None	
FDA Warning	Warning: smoking causes fatal lung disease	Warning: Smoking during pregnancy can harm your baby	Warning: Tobacco smoke can harm your children
Graphicness	1.6	Note: Max graphicness 3.0	1.7
Name	Low Graphic 4	NA	Low Graphic 6

Image			
FDA Warning	Warning: Cigarettes are addictive	Warning: quitting smoking now greatly reduces serious risks to your health	Warning: Smoking causes fatal lung disease in nonsmokers
Graphicness	1	0.6	1.3
Name	Low Graphic 7	Low Graphic 8	Low Graphic 9

Note: All images have had text warnings photo shopped out.

Mixed Condition 1 M=3.2



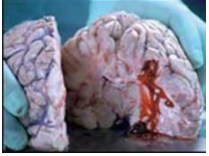
Image			
FDA Warning	Warning: Cigarettes cause cancer	Warning: Smoking can kill you	Warning: Cigarettes cause strokes and heart disease
Graphicness	5.6	1.8	4.8
Name	High Graphic 1	Low Graphic 2	High Graphic 3



Image		None	
FDA Warning	Warning: smoking causes fatal lung disease	Warning: Smoking during pregnancy can harm your baby	Warning: Tobacco smoke can harm your children
Graphicness	1.6	Note: Max graphicness 3.0	5.1
Name	Low Graphic 4	NA	High Graphic 6

Image			
FDA Warning	Warning: Cigarettes are addictive	Warning: quitting smoking now greatly reduces serious risks to your health	Warning: Smoking causes fatal lung disease in nonsmokers
Graphicness	1	4.7	1.3
Name	Low Graphic 7	High Graphic 8	Low Graphic 9

Mixed condition 2 M= 2.95



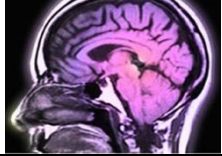
Image			
FDA Warning	Warning: Cigarettes cause cancer	Warning: Smoking can kill you	Warning: Cigarettes cause strokes and heart disease
Graphicness	1.4	4.6	1.4
Name	Low Graphic 1	High Graphic 2	Low Graphic 3






Image		None	
FDA Warning	Warning: smoking causes fatal lung disease	Warning: Smoking during pregnancy can harm your baby	Warning: Tobacco smoke can harm your children
Graphicness	5.2	Note: Max graphicness 3.0	1.7
Name	High Graphic 4	NA	Low Graphic 6

Image			
FDA Warning	Warning: Cigarettes are addictive	Warning: quitting smoking now greatly reduces serious risks to your health	Warning: Smoking causes fatal lung disease in nonsmokers
Graphicness	4.7	0.6	4.0
Name	High Graphic 7	Low Graphic 8	High Graphic 9

Text-only condition

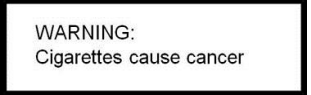
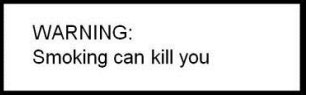
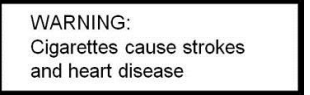
Image			
FDA Warning	Warning: Cigarettes cause cancer	Warning: Smoking can kill you	Warning: Cigarettes cause strokes and heart disease
Graphicness	1.4	4.6	1.4
Name	No Graphic 1	No Graphic 2	No Graphic 3

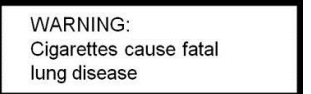
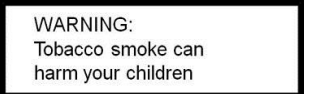
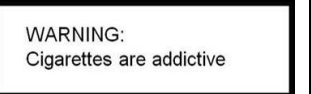
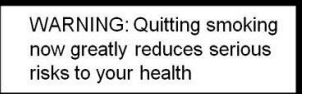
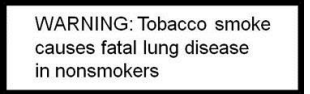
Image		None	
FDA Warning	Warning: smoking causes fatal lung disease	Warning: Smoking during pregnancy can harm your baby	Warning: Tobacco smoke can harm your children
Graphicness	5.2	Note: Max graphicness 3.0	1.7
Name	No Graphic 4	NA	No Graphic 6

Image			
FDA Warning	Warning: Cigarettes are addictive	Warning: quitting smoking now greatly reduces serious risks to your health	Warning: Smoking causes fatal lung disease in nonsmokers
Graphicness	4.7	0.6	4.0
Name	No Graphic 7	No Graphic 8	No Graphic 9

Appendix 2: Individual Difference Measures

Number of items	Time Estimate	Immediate Condition	One-week Delay Condition	Six-week Delay Condition
8	1	Prescreening (includes demographic questions)	Prescreening	Prescreening
1	1	Consent	Consent	Consent
1	0	Enter Mechanical Turk ID	Enter Mechanical Turk ID	Enter Mechanical Turk ID
1		Instructions	Instructions	Instructions
Baseline Measures				
20	4	TOHFLA Passage B	TOHFLA Passage B	TOHFLA Passage B
Variable	5	Working memory	Working memory	Working memory
8	5	8 item numeracy	8 item numeracy	
10	1.5	Industry advertising and promotion	Industry advertising and promotion	Industry advertising and promotion
2	.5	Media use	Media use	Media use
10	1.5	Demographics	Demographics	Demographics
26	4	Tobacco use (e.g., age at 1 st and Fagerstrom)	Tobacco use (e.g., age at 1 st and Fagerstrom)	Tobacco use (e.g., age at 1 st and Fagerstrom)
12	2	Primack ST Acceptability	Primack ST Acceptability	Primack ST Acceptability
4	.5	Past week tobacco use	Past week tobacco use	Past week tobacco use
1	0	Past week think about smoking health risks	Past week think about smoking health risks	Past week think about smoking health risks
Time	23	Total pre- exposure (estimate day 1 delay condition)		
Exposure to 8 warning labels				
8	1.5	Exposure to stimuli	Exposure to stimuli	Exposure to stimuli

Follow up measures (either immediate or after 1- or 6-week delay)				
13	2	Tobacco use risk perceptions	Week 1	Week 6
2	.5	Endorsement of smoking myths	Week 1	Week 6
2	.5	Quit intentions and next week expected tobacco use	Week 1	Week 6
8	4	Free recall	Week 1	Week 6
8	2	Cued recall	Week 1	Week 6
18	2	Recognition memory	Week 1	Week 6
40; 5/item	6	Manipulation check	Week 1	Week 6
8	1.5	Warning credibility	Week 1	Week 6
1	.5	Longitudinal study contact permission	Week 1	Week 6
Time	18.5	Summary after exposure (estimate for day 2)		
Time	43.5	Total Immediate condition		
Follow up measures (either immediate or after 1- or 6-week delay)				
13	2		Tobacco use risk perceptions	Tobacco use risk perceptions
2	.5		Endorsement of smoking myths	Endorsement of smoking myths
3	.5		Past week tobacco use	Past week tobacco use
2	2		Quit intentions and next week expected tobacco use	Quit intentions and next week expected tobacco use
8	4		Free recall	Free recall
8	2		Cued recall	Cued recall
18	8		Recognition memory	Recognition memory
40; 5/item	6		Manipulation check	Manipulation check
8	1		Warning credibility	Warning credibility

1	.5		Past week think about smoking health risks	Past week think about smoking health risks
2	.5		Information rehearsal and depth of processing	Information rehearsal and depth of processing
4	.5		Exposure/response to warnings	Exposure/response to warnings
1	.5		Longitudinal study contact permission	Longitudinal study contact permission